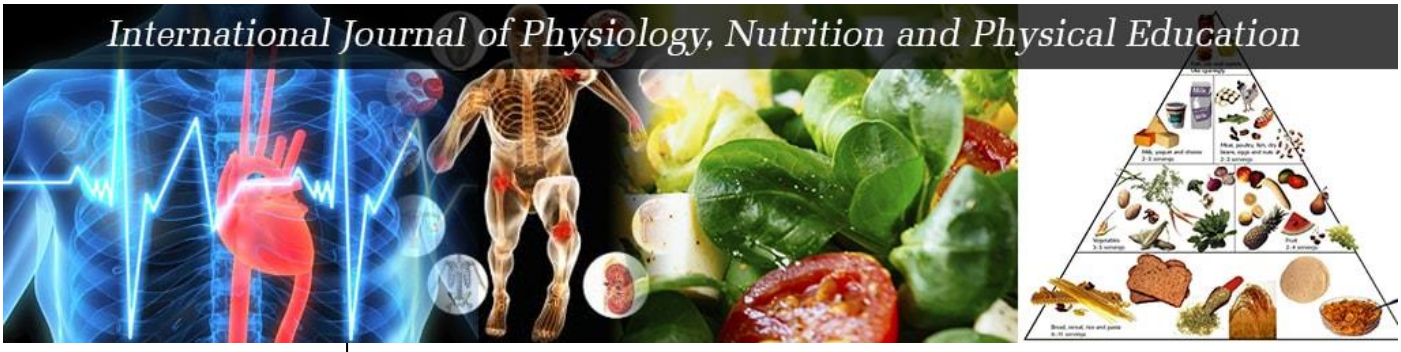

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Comparative study of maximal oxygen uptake among sedentary female workers

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Abstract
Objective: The objective of the current study was to compare the Vo2 Max of sedentary female workers in relation to the four disciplines that were chosen.
Method: The total eighty (twenty sedentary female workers from each discipline) female subjects ranging from 36 to 45 years (Mean ± SD; Age 39.53±2.77 years, Height 1.58±0.05 metre, Weight 61.84±6.77 kg) of age were selected from the different offices of southern region of Bengal (i.e., Purba Bardhaman, Paschim Bardhaman, West Midnapore, Jhargram and Birbhum). The maximum oxygen uptake (VO2 max) is measured using the Queen College Step Test. To compare all the means of Vo_2 Max scores measured from sedentary female workers in selected disciplines, one-way analysis of variance (ANOVA) was used at the 0.05level of significance was set.
Results: There was significant difference found between the Vo_2 Max of the sedentary female workers from selected disciplines. Since, the one-way analysis of variance was found significant.
Conclusion: Age-related declines in VO 2max appear to happen non-linearly along with decreases in physical activity and exercise. This decline is not linear typically happens in the twenties and thirties in sedentary people, whereas athletes show a non-linear decline after reducing or stopping training. Regular exercise improves cardio-respiratory fitness by boosting VO2 max and lowering body fat percentage, which ultimately improves quality of life. Elements with a higher CVD risk, like central obesity, blood pressure is high as well as too much body fat, and low VO_2 max, were brought on by physical inactivity. This study also discovered several strong associations between inactivity and risk factors for CVD include high blood pressure, excessive fat, and low VO_2 max.

Keywords: Vo_2 Max, college workers, forest department workers, school workers and municipality workers and inactive

Introduction
Lack of regular mobilizing activities in daily activities characterizes a sedentary lifestyle. Nowadays, due to modern life, more and more people are not interested in regular physical activity, which is why they lead a sedentary lifestyle. This sedentary life makes people obese. Women who work in official jobs are physically inactive due to busy schedules in the office and at home, leading to poor health. A sedentary lifestyle has been associated with an increased obesity, declined cardiorespiratory fitness, lower resting metabolic rate, weight gain rate increases, and increased probability of metabolic syndrome.
The term "sedentary behaviour," which comes from the Latin word sedere, meaning "to sit" refers to a activities for groups that involve sitting while commuting, at work and home, and during leisure and have low energy demands of 1.0 to 1.5 METs (multiples of the basal metabolic rate) (Thorp AA 2011) [56]. Any activity, including dozing off, sitting or lying down, watching television, or engaging in other screen-based activities, Sedentary behaviour is defined as any activity that does not significantly increase energy expenditure above the resting level. (Pate RR *et al*. 2008) [40]. Sedentary behaviour, according to SBRN, is any waking activity that requires 1.5 METs of energy to perform while seated or lying down. (Network SBR 2012) [33]. Sedentary behaviour, on the other hand, is a significant cardiovascular risk factor that is becoming more common in the world's population. Cardiovascular output affects maximum oxygen uptake or VO_2 max. and the arteriovenous oxygen variance (Bruce AR 1973 & Carreira MA 2007) [9, 10]. A widely used indicator of cardiorespiratory fitness, maximum oxygen uptake or VO_2 max, reflects how much oxygen is consumed by active muscles.

(McArdle WD *et al*., 1986**)** [32]**.** VO2 Max is the maximum amount of oxygen a person can consume and it's measured in millilitres, how much the amount of oxygen used in one minute, for each kilo of body weight (mL/kg/min).

Males who are moderately active have a VO2max of around 35 to 40 mL/kg/min, whereas females have a VO2max of around 26-30 mL/kg/min **(**David D 2023**)** [57]. VO2max (ml/kg/min) is declines at a rate of about 1.6% percent per year **(**Hakola L *et al*., 2011**)** [19]. VO2max 5-10% reduction of life has been observed in their case not involved in daily physical activity. VO2max (ml/kg/min) is declines at a rate of about 1.6% percent per year (Shete AN *et al*., 2014) [51]. VO2 max or maximal oxygen uptake is a important prognostic index and a dependable measure of physical exertion. Obesity, high blood pressure, diabetes, smoking, and an inactive lifestyle are the most prevalent risk factors. Most of our young people today lead sedentary lives as a result of excessive exposure to technology like television, computers, and the internet.

A few of the factors that contribute to the age-related decline in Reduced maximal heart rate and stroke volume, decreased blood volume due to pooling from less effective muscle pump action of the valves in the extremities, stiffer heart muscle fibers, thicker and stiffer arterial walls, and decreased marginal oxygen extraction are all examples of VO2max, and optimal A-V O2 modification. (Lakatta EG, Levy 2003, Tanaka H, Seals DR 2008, & North BJ, Sinclair DA. 2008) [29, 55, 34].

Sarcopenia, or the debility in VO_2 max seems to be significantly influenced by age-related muscle loss. (Mazzeo RS. 2014) [31]. Fleg and Lakatta (1988) [14] asserted that a debility in VO_2 max with aging in sedentary people was a result of whole-body lean mass (Fleg JL, Lakatta EG. 1988) [14]. The age-related decrease in VO2max is also influenced by decreased cardiac output and blood supply. (Rivera AM *et al*, 1989 & Ogawa T 1992) [47, 35]. Body mass, age, level of physical exercise, and the presence of cardiorespiratory disease all affect VO2 max (Bruce AR 1973, Ong KC 2002 & Froelicher VF 2000) [9, 37, 16]. Sedentary behavior, on the other hand, is a significant cardiovascular risk factor that is becoming more common in the world's population (Yusuf S *et al*., 2004) [62].

Physiologists have been intrigued by the quest to understand what restricts our capacity to utilize oxygen to its maximum during exercise, or VO_2 max, as stated by Hill *et al*. in 1924 [24]. However, because VO_2 max declines with aging, elderly individuals' capacity to carry out daily activities depends significantly on VO_2 max, as opposed to the majority of healthy individuals. It could be argued that VO_2 max has little to do with daily life and that it is less of a practical concern what limits VO_2 max (Paterson *et al*., 2004) [41]. This makes the fact that finding practical ways to maintain the capacity to lead an independent lifestyle while also comprehending the physiological bases and it's important to note that VO_2 max decreases with age.

The decrease when VO_2 max that comes aging is brought on by a variety of factors, some of which may not be equally significant throughout the lifespan. For instance, the evidence at this time suggests that muscles are receiving less blood flow (Proctor *et al*. 1998a; Wahren *et al*. 1974) [46], because of lower maximum cardiac output and perhaps an issue with the output distribution (Proctor *et al*. 1998a, 1998b) [46], is mostly to blame for the debility in VO_2 max that comes with age in people younger than 65. According to The American Heart Association (AHA) use of VO_2 max/peak as a measure of cardiorespiratory fitness is common practice (Ross *et al*. 2016) [49]. The average undeveloped female's VO2 max ranges from about 27 to 31 mL/(kg/min) (Heyward, V 1998) [23]. These scores can rise with practice or fall with age, but the degree to which they are trainable also varies greatly (Williams *et al*., 2017) [6].

The Study's Objective

The current study's objective was to compare the Vo2 Max of sedentary female workers across the four selected disciplines, the disciplines are General College Workers and Forest Department Workers, General College Workers and Municipality Workers. The total of 80 female subjects, aged 36 to 45. For the study, 20 sedentary female employees from each discipline are chosen.

Methodology

Participants

To smooth the progress of the study, total eighty (twenty sedentary female workers from each discipline) female subjects ranging from 36 to 45 years (Mean ±SD; Age 39.53±2.77 years, Height 1.58±0.05 metre, Weight 61.84±6.77 kg) of age were selected from the different offices of southern region of Bengal (i.e., Purba Bardhaman, Paschim Bardhaman, West Midnapore, Jhargram and Birbhum). Subjects were divided into four disciplines (each discipline consists of twenty sedentary female workers) on the basis of their discipline (General College Workers, Forest Department Workers, Primary School Workers and Municipality Workers). The required data were collected using the purposive sampling technique. Keeping in mind the study's variables' relevance and the criteria for feasibility. The subjects received all the required information regarding the necessity of the testing procedure.

Measures

Queen's College Step Test for the Measurement of VO_2 max. VO_2 max was measured indirectly using the Queen's College Step Test (McArdle *et al*., 1972) [58]. Subjects moved up and down on a 16.25-inch stool for three minutes at a rate of 22 steps per minute. The metronome keeps pace. After three minutes of stepping, Subjects are stopped immediately after completing the test and heart rate is counted for 15 seconds from 5 seconds to a 20 second rest. The following equation is used to calculate VO2max (ml.kg-1.min-1). VO2 max estimates can be calculated from the test results, using this formula (McArdle *et al*., 1972) [58].

VO_2 Max (ml/kg/min)=65.81-(0.1847 × heart rate (BPM/ rate of heartbeat)

Data Analysis

Prior to information analysis, data screening was used to ensure that all established variables met the fundamental assumptions for the use of parametric data. Additionally, one-way Analysis of Variance (ANOVA) was once used to identify between-group variations. The degree of magnitude used to be set at 0.05 to test the hypothesis. LSD examines the Post-Hoc Test, which was once used for additional analysis. Model 20.0 of the Statistical Package for Social Science (SPSS) was previously applied.

Results

Table 1 displays the average, standard deviation, standard error of mean, as well as the minimum and maximum values.

related to Maximal Oxygen Uptake among selected sedentary female workers related to the selected four disciplines General College Workers, Forest Department Workers, Primary School Workers and Municipality Workers.

Table 1: Descriptive Statistics related to Maximal Oxygen Uptake among selected sedentary female workers from different disciplines

	Numbers	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
General College Workers	20	32.99	1.93	0.43	32.08	33.89	28.86	35.74
Forest Department Workers	20	35.83	1.05	0.24	35.34	36.33	34.30	37.74
Primary School Workers	20	33.09	2.18	0.49	32.07	34.11	28.52	37.00
Municipality Workers	20	37.55	0.93	0.21	37.11	37.98	34.78	38.52

Table 1 point towards the means of Maximal Oxygen Uptake score measured in selected sedentary female worker groups related to different disciplines. The highest mean (37.55) of Vo_2 Max was found in Municipality Workers and the least mean (32.99) was in General College Workers. Similarly the highest Std. Deviation (2.18) was found in Primary School Workers and the lowest Std. Deviation (0.93) was found in Municipality Workers. As opposed to that the maximum value of Vo_2 Max 38.52 ml/Kg/min was found in Municipality Workers, which is indicating of good Oxygen Uptake.

Figure 1's graphics, which show the dependent variable (Maximal Oxygen Uptake) on the Y axis and the independent variable (Different Disciplines) on the X axis, make it very simple to understand the above findings.

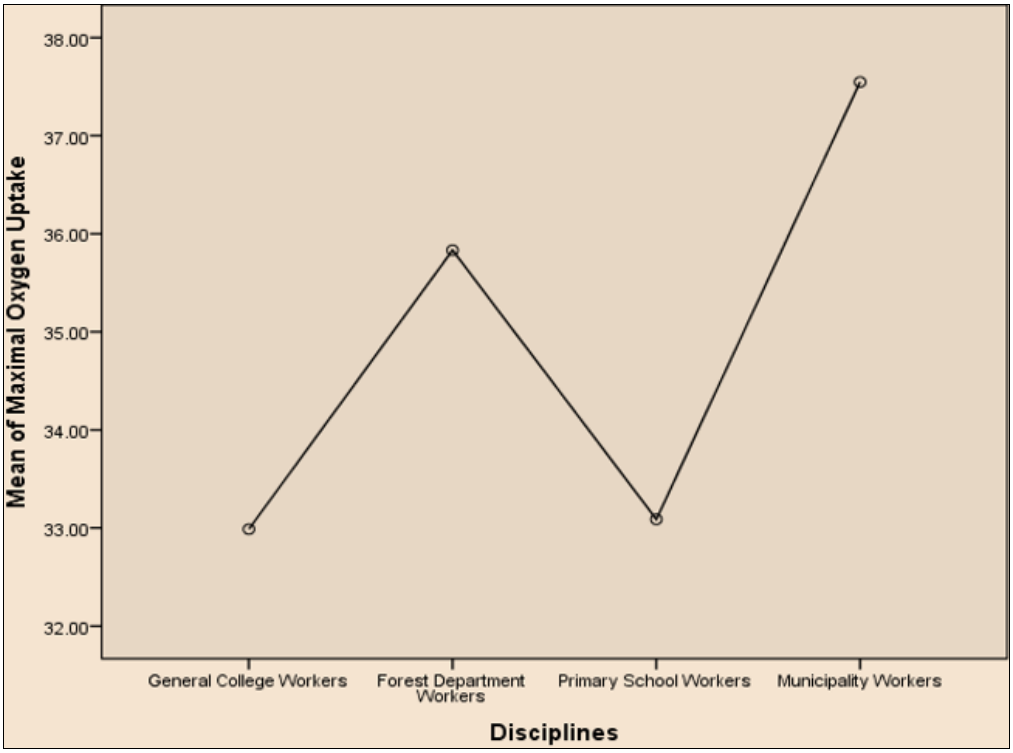

Fig 1: Means Plot displaying the group means of maximal oxygen uptake for a sample of sedentary female workers from various disciplines.

Figure 1 shows that among Municipality Workers, the mean value of Maximal Oxygen Uptake is higher than average (37.55) in comparison to that of General College Workers (32.99), Forest Department Workers (35.83) and Primary School Workers (33.09). Based on the aforementioned findings, it can be deduced that among workers in the various disciplines, Municipality Workers have the highest Vo2 Max and General College Workers have the lowest.

Table 2: Results of Analysis of Variance (ANOVA) for sedentary female workers and maximal oxygen uptake across various disciplines

	Group	Sum of Squares	df	Mean Square	F	Sig.
Maximal Oxygen Uptake	Between Groups	296.29	3	98.76	37.74	0.00*
	Within Groups	198.87	76	2.62		

* At the 0.05 level, the mean difference is significant.

Table 2 makes clear that the outcomes of the Analysis of Variance (ANOVA) indicates that there was a significant difference in Vo_2 Max values among sedentary female workers of different disciplines because $p < 0.05$ and F value is 37.74, which is discovered a value greater than critical i.e. $F_{(0.05, 3,76)} = 2.73$.

The null hypothesis that there is no difference in the means of the four disciplines is rejected because the F-value is significant. Therefore, the Post-hoc test (LSD) was used to compare the paired means of the workers from the General College, the Forest Department, the Primary School, and the Municipality in terms of their maximum oxygen uptake while sedentary. Table 3 displays the outcomes of the Post-hoc test.

Table 3: Assessment of Mean Values of Maximal Oxygen Uptake in Post-Hoc Test (LSD) among different disciplines

(I) Disciplines	(J) Disciplines	Mean Difference (I-J)	Std. Error	Sig. (p-value)
General College Workers	Forest Department Workers	-2.85*	0.51	0.00
	Primary School Workers	-0.10	0.51	0.85
	Municipality Workers	-4.56*	0.51	0.00
Forest Department Workers	General College Workers	2.85*	0.51	0.00
	Primary School Workers	2.74*	0.51	0.00
	Municipality Workers	-1.72*	0.51	0.00
Primary School Workers	General College Workers	0.10	0.51	0.85
	Forest Department Workers	-2.74*	0.51	0.00
	Municipality Workers	-4.46*	0.51	0.00
Municipality Workers	General College Workers	4.56*	0.51	0.00
	Forest Department Workers	1.72*	0.51	0.00
	Primary School Workers	4.46*	0.51	0.00

* At the 0.05 level, the mean difference is significant.

From Table 3, it can be seen that the difference in means of maximal oxygen uptake between general college workers and employees of the forest department and general college workers and employees of municipalities is significant at the 5% level. The p-value for this mean difference is 0.00, which is less than 0.05. Similar to this, the p-value is 0.00, which is less than 0.05, for the significance of the difference between forest department workers and municipal workers and forest department workers and primary school workers in terms of their means of maximal oxygen uptake. Accordingly, because the p-value is less than 0.05, there is a significant difference between the means of Primary School Workers and Municipality Workers in terms of Maximal Oxygen Uptake.

Discussion

The Vo2 Max of the sedentary female workers from a few different disciplines varied significantly. The LSD test was computed because the one-way analysis of variance revealed a significant result. Since this mean difference's p-value is 0.00, it is less than 0.05, the Post Hoc test demonstrated that the difference between General College Workers and Forest Department Workers, General College Workers and Municipality Workers on their in terms of means of Maximal Oxygen Uptake is significant at 5% level. Similar to this, the p-value is 0.00, which is less than 0.05, for the significance of the difference between forest department workers and municipal workers and forest department workers and primary school workers in terms of their means of maximal oxygen uptake. As a result, there is a significant difference between the means of Primary School Workers and Municipality Workers in terms of Maximal Oxygen Uptake because the p-value is less than 0.05. Finally, it was discovered that desk-bound workers are more likely to experience respiratory and other circulatory complaints due to the lower mean values of maximal oxygen uptake.

Age-related decline in the metric occurs at a 10% per decade rate after the normal individual, in their late 20s or early 30s, reaches their peak. The amount of blood that our hearts can pump also contributes to our aerobic capacity. The heart is one of the larger organs in men than in women. More blood can be pumped into the system thanks to the larger size of the heart. From middle age, aging with a sedentary lifestyle reduces VO2max by about 1% per year, while an active lifestyle reduces the decline by half. (Sherwood L. 2016) [50].

Future cardiovascular disease mortality is predicted by low physical activity and poor cardiovascular health. (Ekelund LG *et al*. 1988) [12].

Because of their duties at work, employees frequently spend long stretches of time sitting. According to a different study, inefficient use of time, not being interested and a propensity to engage in various other activities the three main obstacles to physical movement.

The focus of this thesis of is to investigate the relationship between the cardiovascular health of university staff members and their physical activity habits. Many chronic conditions, including type 2 diabetes and cardiovascular disease (CVD), and some cancers, are at risk due to physical inactivity. According to Alkhatib, 2013 [1] many studies have not gone into detail about university staff members' levels of physical inactivity, who could be considered a potential sedentary population.

Sedentary individuals infrequently involve in physical movement. A person who leads a Sedentary behaviour devotes they spend most of their time lying or sitting when they are doing things like to use their smartphone, study, watch television, or play computer games. (Peterson & Cheng, 2012) [43]. As per studies, the people who participated in no actual work had a 27% higher gamble of creating diabetes and a 30% higher gamble of cardiovascular illness (Backer, 2007; Oja & Titze, 2011) [4, 36].

Alkhatib (2015) [2] argued that employees in a campus workplace had a high prevalence of sedentary lifestyles in addition to unfavourable health concerns. Office workers who were inactive physically had higher healthcare costs (Garret *et al*., 2004; Wilkerson *et al*., 2008; Hill *et al*. 2009) [21, 17, 59].

A lack of time (63 percent) was the primary factor that kept these university employees from engaging in physical activity. Most of an office specialist's day is spent plunking down; they would, however, be able to increase their work-related passive energy expenditure if they purchased an adjustable standing desk. Without becoming inactive, Office workers have the freedom to spend a lot of time in their offices.

Finally, university staff members can conduct walking meetings as opposed to gathering in a room. Oppezzo & Schwartz (2014) [38] discovered that in terms of stimulating creative thinking, walking meetings outperformed traditional sit-down meetings. During walking meetings, office workers can discuss the projects they're working on with their co-workers, which encourages them to come up with fresh approaches to issues. Additionally, walking meetings give employees the chance to work out while still being productive by lowering their CVD risk and number of sick days.

One of the best indicators of longevity and cardiovascular health is cardiorespiratory fitness (CRF) (Berry JD *et al*. 2011) [6]. Recent epidemiologic data suggests that there are differences between the long-term health effects of routinely engaging in sedentary behavior and those of engaging in too

little or no moderate-intensity physical activity. (Shiroma E, Lee 2010, Haskell WL *et al*, 2009 & Owen N *et al*., 2010) [56, 21, 52]. Low energy expenditure behaviours are referred to as sedentary behaviours (Owen N *et al*., 2010) [56].

Numerous observational studies have demonstrated the burden of sedentary behaviour appears to be a separate risk factor that is independent of physical activity levels, with increased risk for total all-cause and cardiovascular mortality for those individuals with increased sedentary time. One of the primary causes of the risks of low physical movement is sedentary behaviour. (Bankoski A 2011, Chomistek AK *et al*., 2013) [5, 11]. Uncertainty surrounds the mechanism by which sedentary behaviour might raise the risk. Obesity, the metabolic syndrome, low lipoprotein lipase levels, insulin resistance, and microvascular dysfunction have all been linked to inactivity. (Bankoski A 2011, Healy GN *et al*., 2003) [5]. The study's conclude and indicate that sedentary behaviour significantly influences CRF levels independently of physical activity.

Conclusion

In the present research, we found that VO_2 max is statistically significant and also found that mean vo2 max was poor in sedentary working women. Physical fitness is a prerequisite for all activities in our society. Therefore, we conclude that sedentary life style decrease cardiorespiratory fitness by decreasing vo2 max.

It was once thought that a person's lack of physical fitness was linked to a higher mortality rate. According to Fleg and Lakatta (1988) [14], total body lean body mass was demonstrated to be a factor in the sedentary population's VO_2 max drops dramatically.

Because of a sedentary lifestyle that can cause a number of health issues therefore, we recommend that working women with sedentary lifestyles need regular physical exercise to improve cardiorespiratory fitness levels, thereby avoiding complications of poor cardio respiratory fitness and improving quality of life. These results suggest that the risks associated with sedentary behaviour may be mediated in part by low levels of fitness (Jacquelyn P. & Kulinski, *et al*., 2014) [27]. Along with reduces in participation in physical activity, age-related declines in VO_2 max appear to occur non-linearly. Athletes exhibit an irregular decline after reducing or stopping training, whereas this an irregular decline typically occurs in sedentary people in their 20s and 30s.

Regular exercise improves cardio-respiratory fitness by boosting VO2 max and lowering body fat percentage, which ultimately improves quality of life. Higher CVD risk factors, Physical inactivity led to conditions like excessive body fat, hypertension, central obesity, and low VO_2 max. This study also discovered several strong associations between inactivity and CVD risk elements include high blood pressure, central obesity, and low VO2 max.

When compared to other barriers, such as a preference for other activities, a lack of enjoyment, and the absence of a partner for exercise, and a lack of confidence, a lack of time was the most frequently mentioned. It may be possible and helpful to increase physical activity by using an adjustable standing desk and walking meetings. A meta-analysis contrasting related to age reductions in highest aerobic capacity in active and inactive women. (J. Appl. & Physiol. 1997)

Sedentary behaviour appears to have an inverse association with fitness after accounting for exercise activity. These findings suggest that sedentary behaviour-related risk may be partially mediated by lower fitness levels. Avoiding sedentary behaviour is one possible way to improve health benefits that are not dependent on regular exercise in addition to the advantages of moderate exercise.

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